

Claims

1. An exhaust gas purification apparatus disposed in an exhaust gas passage of an internal combustion engine having a NOx purification catalyst, which comprises a sulfur component trapping agent for trapping sulfur components, which is arranged before the NOx trapping catalyst and a catalyst for oxidizing the sulfur components, disposed before the sulfur component trapping agent, wherein the sulfur component trapping agent does not substantially release the trapped sulfur components under the conditions of the internal combustion engine.

2. An exhaust gas purification apparatus for an internal combustion engine, which comprises an exhaust gas passage for an internal combustion engine into which exhaust gas of lean air fuel ratio and rich or stoichiometric air fuel ratio flows, a NOx trapping catalyst that functions to trap NOx in the exhaust gas when the air fuel ratio is lean, a sulfur component trapping agent for trapping sulfur components in the exhaust gas, which is disposed before the NOx trapping catalyst, and a catalyst for oxidizing the sulfur components, which is disposed before the sulfur component trapping agent, wherein the sulfur component trapping agent has a trapping rate of 85 % or more of an amount of inflow sulfur in a trapping test at a flow rate of 150 ppm SO₃ - 5% O₂ - balance being N₂ gas per 1.5 moles of

the sulfur component trapping agent at 300 °C and a space velocity of 30,000/h for 1 hour;

and the sulfur component trapping agent has a release rate of sulfur amount of 5 % or less of sulfur trapped in the sulfur component trapping agent in a release test under a flow of a 3000 ppm H₂ - 600 ppm C₃H₆ - 3000 ppm O₂ - 3.5 % CO - balance being N₂ gas at a temperature elevation rate of 10 °C/min from 250 to 750 °C at an sulfur component trapping agent entrance, after the trapping test.

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3. An exhaust gas purification apparatus for an internal combustion engine, which comprises an exhaust gas passage for an internal combustion engine into which exhaust gas of lean air fuel ratio and rich or stoichiometric air fuel ratio flows, a NO_x trapping catalyst that functions to trap NO_x in the exhaust gas when the air fuel ratio is lean, a sulfur component trapping agent for trapping sulfur components in the exhaust gas, which is disposed before the NO_x trapping catalyst, and a catalyst for oxidizing the sulfur components, which is disposed before the sulfur component trapping agent, wherein the sulfur component trapping agent has a trapping rate of 60 % or more of an amount of inflow sulfur in a trapping test at a flow rate of 150 ppm H₂S - 0.5% O₂ - balance being N₂ gas at 300 °C of the sulfur trapping agent and a space velocity of 30,000/h for 1 hour.

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4. An exhaust gas purification apparatus for an internal combustion engine, which comprises a NOx trapping catalyst for trapping NOx, which is disposed in an exhaust gas passage, a sulfur component trapping agent disposed before the NOx trapping catalyst for trapping sulfur components, and a catalyst disposed before the sulfur component trapping agent for oxidizing the sulfur components, wherein the sulfur component trapping agent contains at least one of alkali metals and alkaline earth metals and a total amount of Pt, Pd and Rh is at least 0.4 % by weight of the sulfur component trapping agent.

5. The exhaust gas purification apparatus according to any one of claims 1 to 4, wherein the sulfates contained in the sulfur component trapping agent has a melting temperature or decomposition temperature of 750 °C or higher.

6. The exhaust gas purification apparatus according to any one of claims 1 to 5, wherein the sulfur component trapping agent is disposed below the engine.

7. The exhaust gas purification apparatus according to claim 1, which further comprises a filter disposed in upstream of the NOx trapping catalyst, wherein an upstream side of the filter

is provided with a catalyst for oxidizing the sulfur components and a downstream side of the filter is provided with the sulfur component trapping agent.

5 8. The exhaust gas purification apparatus according to any one of claims 1 to 5, which further comprises a filter disposed at upstream of the NO_x trapping catalyst, wherein the sulfur component trapping agent is formed on part of the filter, and the catalyst for oxidizing sulfur components is formed on
10 another part of the filter.

9. The exhaust gas purification apparatus according to claim 4, wherein an amount of the alkali metals or the alkaline earth metals is 1 to 4 moles or less in terms of (alkali metals /2
15 + alkaline earth metals).

10. The exhaust gas purification apparatus according to any one of claims 1 to 9, wherein the catalyst for oxidizing sulfur components contains at least one of Pt, Pd and Rh.

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11. The exhaust gas purification apparatus according to any one of claims 1 to 10, wherein the NO_x trapping catalyst contains at least one of alkali metals and alkaline earth metals and at least one of noble metals, and has a function to trap SO_x under
25 a lean air fuel condition and a function to release SO_x in a

rich or stoichiometric air fuel condition by heating the catalyst to 500 °C or higher.

12. The exhaust gas purification apparatus according to any
5 one of claims 1 to 11, wherein the sulfur component trapping agent is replaceable with another.

13. A sulfur component trapping agent containing an ingredient for trapping sulfur components in an exhaust gas,
10 wherein the ingredient has a trapping rate of 85 % or more of an amount of inflow sulfur in a trapping test at a flow rate of 150 ppm SO₃ - 5% O₂ - balance being N₂ gas per 1.5 moles of the sulfur trapping agent at 300 °C and a space velocity of 30,000/h for 1 hour;
15 and the sulfur component trapping agent has a release rate of sulfur amount of 5 % or less of sulfur trapped in the sulfur component trapping agent in a release test under a flow of a 3000 ppm H₂ - 600 ppm C₃H₆ - 3000 ppm O₂ - 3.5 % CO - balance being N₂ gas at a temperature elevation rate of 10 °C/min from
20 250 to 750 °C at an sulfur component trapping agent entrance, after the trapping test.

14. The sulfur component trapping agent according to claim 13, wherein the sulfur component trapping agent contains at
25 least one selected from the group consisting of alkali metals,

alkaline earth metals, Ce, Al, Y, La and Ni.

15. A sulfur component trapping agent for trapping sulfur in
an exhaust gas, which comprises a honeycomb substrate made of
5 cordierite or metal, a porous support, and a sulfur trapping
agent supported on the porous support, wherein the sulfur
trapping agent contains 1 to 4 moles of at least one of alkali
metals and alkaline earth metals in (molar number of alkali
metals /2 + molar number of alkaline earth metals) as conversion
10 of elements, and the total amount of Pt + Pd + Rh is 0.4 % by
weight or more per the sulfur component agent.

16. A method of purification of an exhaust gas from an internal
combustion engine, which uses the sulfur component trapping
15 agent according to any one of claims 13 to 15.

17. A method of purification of an exhaust gas for an internal
combustion engine, which comprises oxidizing sulfur components
in the exhaust gas, trapping and accumulating the sulfur
20 components in a sulfur component trapping agent, and purifying
NOx in the exhaust gas with a NOx purifying catalyst.

18. The method of purification of an exhaust gas according to
claim 16 or 17, which comprises a step for releasing the sulfur
25 components from the NOx purifying catalyst, wherein the

releasing step is carried out by changing the air fuel ratio to rich or stoichiometric and elevating temperature of the NOx purifying catalyst to 500 °C or higher.

5 19. A method of diagnosis of degradation of a sulfur component trapping agent in an exhaust gas purification apparatus comprising a NOx purification catalyst, a sulfur component trapping agent disposed before the NOx purification catalyst, and a sulfur component oxidizing catalyst disposed before the
10 sulfur component trapping agent, which comprises measuring NOx purification rates before and after a step of releasing a sulfur component from the NOx purification catalyst and diagnosing a degradation of the sulfur component trapping agent based on a difference or ratio of the NOx purification rates.

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20. A system for diagnosis of degradation of a sulfur component agent in an exhaust gas purification apparatus comprising a NOx purification catalyst for trapping NOx, a sulfur component trapping agent disposed before the NOx purification catalyst
20 for trapping sulfur components, a sulfur component oxidizing catalyst disposed before the sulfur component trapping agent, which comprises means for diagnosing the sulfur component trapping agent in accordance with the diagnosis method defined in claim 19 for every sulfur component releasing step, and means
25 for indicating replacement of the sulfur component trapping

agent when the sulfur component trapping agent is degraded to a predetermined level.